

What Is Claimed Is:

1 1. A method for enhancing reliability, availability and serviceability
2 in a computer system by replacing a signal from a failed sensor with an estimated
3 signal derived from correlations with other instrumentation signals in the
4 computer system, comprising:

5 determining whether a sensor has failed in the computer system; and
6 if the sensor has failed, using an estimated signal for the failed sensor in
7 place of the actual signal from the failed sensor during subsequent operation of the
8 computer system, whereby the computer system can continue operating without
9 the failed sensor;

10 wherein the estimated signal is derived from correlations with other
11 instrumentation signals in the computer system.

1 2. The method of claim 1, wherein determining whether the sensor
2 has failed involves:

3 deriving an estimated signal for a sensor from correlations with other
4 instrumentation signals in the computer system; and
5 comparing a signal from the sensor with the estimated signal to determine
6 whether the sensor has failed.

1 3. The method of claim 2, wherein comparing the signal from the
2 sensor with the estimated signal involves using sequential detection methods to
3 detect changes in the relationship between the signal from the failed sensor and
4 the estimated signal.

1 4. The method of claim 3, wherein the sequential detection methods
2 include the Sequential Probability Ratio Test (SPRT).

1 5. The method of claim 1, wherein prior to determining whether the
2 sensor has failed, the method further comprises determining correlations between
3 instrumentation signals in the computer system, whereby the correlations can
4 subsequently be used to generate estimated signals.

1 6. The method of claim 5, wherein determining the correlations
2 involves using a non-linear, non-parametric regression technique to determine the
3 correlations.

1 7. The method of claim 6, wherein the non-linear, non-parametric
2 regression technique can include a multivariate state estimation technique.

1 8. The method of claim 5, wherein determining the correlations can
2 involve using a neural network to determine the correlations.

1 9. The method of claim 1, wherein the instrumentation signals can
2 include:

3 signals associated with internal performance parameters maintained by
4 software within the computer system;

5 signals associated with physical performance parameters measured
6 through sensors within the computer system; and

7 signals associated with canary performance parameters for synthetic user
8 transactions, which are periodically generated for the purpose of measuring
9 quality of service from an end user's perspective.

1 10. The method of claim 1, wherein the failed sensor can be a sensor
2 that has totally failed, or a sensor with degraded performance.

1 11. A computer-readable storage medium storing instructions that
2 when executed by a computer cause the computer to perform a method for
3 enhancing reliability, availability and serviceability in a computer system by
4 replacing a signal from a failed sensor with an estimated signal derived from
5 correlations with other instrumentation signals in the computer system, the
6 method comprising:

7 determining whether a sensor has failed in the computer system; and
8 if the sensor has failed, using an estimated signal for the failed sensor in
9 place of the actual signal from the failed sensor during subsequent operation of the
10 computer system, whereby the computer system can continue operating without
11 the failed sensor;

12 wherein the estimated signal is derived from correlations with other
13 instrumentation signals in the computer system.

1 12. The computer-readable storage medium of claim 11, wherein
2 determining whether the sensor has failed involves:
3 deriving an estimated signal for a sensor from correlations with other
4 instrumentation signals in the computer system; and
5 comparing a signal from the sensor with the estimated signal to determine
6 whether the sensor has failed.

1 13. The computer-readable storage medium of claim 12, wherein
2 comparing the signal from the sensor with the estimated signal involves using

3 sequential detection methods to detect changes in the relationship between the
4 signal from the failed sensor and the estimated signal.

1 14. The computer-readable storage medium of claim 13, wherein the
2 sequential detection methods include the Sequential Probability Ratio Test
3 (SPRT).

1 15. The computer-readable storage medium of claim 11, wherein prior
2 to determining whether the sensor has failed, the method further comprises
3 determining correlations between instrumentation signals in the computer system,
4 whereby the correlations can subsequently be used to generate estimated signals.

1 16. The computer-readable storage medium of claim 15, wherein
2 determining the correlations involves using a non-linear, non-parametric
3 regression technique to determine the correlations.

1 17. The computer-readable storage medium of claim 16, wherein the
2 non-linear, non-parametric regression technique can include a multivariate state
3 estimation technique.

1 18. The computer-readable storage medium of claim 15, wherein
2 determining the correlations can involve using a neural network to determine the
3 correlations.

1 19. The computer-readable storage medium of claim 11, wherein the
2 instrumentation signals can include:

3 signals associated with internal performance parameters maintained by
4 software within the computer system;
5 signals associated with physical performance parameters measured
6 through sensors within the computer system; and
7 signals associated with canary performance parameters for synthetic user
8 transactions, which are periodically generated for the purpose of measuring
9 quality of service from an end user's perspective.

1 20. The computer-readable storage medium of claim 11, wherein the
2 failed sensor can be a sensor that has totally failed, or a sensor with degraded
3 performance.

1 21. An apparatus that enhances reliability, availability and
2 serviceability in a computer system by replacing a signal from a failed sensor with
3 an estimated signal derived from other instrumentation signals correlations with in
4 the computer system, comprising:
5 a failure determination mechanism configured to determine whether a
6 sensor has failed in the computer system; and
7 a sensor replacement mechanism, wherein if the sensor has failed, the
8 sensor replacement mechanism is configured to, use an estimated signal for the
9 failed sensor in place of the actual signal from the failed sensor during subsequent
10 operation of the computer system, whereby the computer system can continue
11 operating without the failed sensor;
12 wherein the estimated signal is derived from correlations with other
13 instrumentation signals in the computer system.

1 22. The apparatus of claim 21, wherein the failure determination
2 mechanism is configured to:

3 derive an estimated signal for a sensor from correlations with other

4 instrumentation signals in the computer system; and to

5 compare a signal from the sensor with the estimated signal to determine
6 whether the sensor has failed.

1 23. The apparatus of claim 22, wherein while comparing the signal
2 from the sensor with the estimated signal, the failure detection mechanism is
3 configure to use sequential detection methods to detect changes in the relationship
4 between the signal from the failed sensor and the estimated signal.

1 24. The apparatus of claim 23, wherein the sequential detection
2 methods include the Sequential Probability Ratio Test (SPRT).

1 25. The apparatus of claim 21, further comprising a correlation
2 determination mechanism, which is configured to determine correlations between
3 instrumentation signals in the computer system, whereby the correlations can
4 subsequently be used to generate estimated signals.

1 26. The apparatus of claim 25, wherein the correlation determination
2 mechanism is configured to use a non-linear, non-parametric regression technique
3 to determine the correlations.

1 27. The apparatus of claim 26, wherein the non-linear, non-parametric
2 regression technique can include a multivariate state estimation technique.

1 28. The apparatus of claim 25, wherein the correlation determination
2 mechanism is configured to use a neural network to determine the correlations.

1 29. The apparatus of claim 21, wherein the instrumentation signals can
2 include:

3 signals associated with internal performance parameters maintained by
4 software within the computer system;
5 signals associated with physical performance parameters measured
6 through sensors within the computer system; and
7 signals associated with canary performance parameters for synthetic user
8 transactions, which are periodically generated for the purpose of measuring
9 quality of service from an end user's perspective.

1 30. The apparatus of claim 21, wherein the failed sensor can be a
2 sensor that has totally failed, or a sensor with degraded performance.